

CLAIMS

What is claimed is:

1. A method of blocking a tubular anatomical structure, comprising the steps of:
grasping tissue on the interior of said tubular anatomical structure to form a tissue bundle
5 comprising tissue from around the circumference of said tubular anatomical
structure; and
applying a ligating structure to said tissue bundle.

10 2. The method of claim 1, wherein said tubular anatomical structure is a fallopian
tube.

3. The method of claim 1, wherein said ligating structure is a ligating band

15 4. The method of claim 1, comprising the further steps of:
grasping tissue on the interior of said tubular anatomical structure at a second location to
form a second tissue bundle comprising tissue from around the circumference of
said tubular anatomical structure; and
applying a second ligating structure to said second tissue bundle.

20 5. A method of ligating a tubular anatomical structure having a wall surrounding a
central lumen, comprising the steps of:
inserting a first end of an elongated tubular element into the lumen of the tubular
anatomical structure, at least one ligating structure being secured at said first end
of said tubular element;
25 extending a grasper out of said first end of said tubular element and through said at least
one ligating structure;
grasping tissue from the wall of said tubular anatomical structure with said grasper;
retracting said grasper into said first end of said tubular element, drawing the grasped
tissue with said grasper into said first end of said tubular element and through said

ligating structure to form a tissue bundle within said first end of said tubular element; and
releasing said at least one ligating structure from said first end of said tubular element to contract about said tissue bundle to form a ligation of said tubular anatomical structure;
5 freeing said tissue bundle from said grasper; and
withdrawing said tubular element from said tubular anatomical structure.

6. The method of claim 5, wherein said step of withdrawing comprises withdrawing said tubular element completely from said tubular anatomical structure.

7. The method of claim 5, wherein at least two ligating structures are secured at said first end of said tubular element, wherein said step of withdrawing comprises withdrawing said tubular element partially from said tubular anatomical structure to a new position within said tubular anatomical element, and wherein said method comprises the further step of:
15 repeating said steps of extending, retracting, releasing, freeing and withdrawing to form a second ligation of said tubular anatomical structure.

8. The method of claim 5, wherein said grasper comprises an elongated catheter having an inflatable end portion and a plurality of hooking structures positioned about and capable of moving with said inflatable end portion, and wherein said step of grasping comprises:
inflating said inflatable end portion until at least a portion of said plurality of hooking structures are forced into said wall of said tubular anatomical structure to grasp
25 tissue of said wall; and
deflating said inflatable end portion until it is capable of fitting into said first end of said elongated tubular element.

9. The method of claim 8, wherein said step of freeing comprises passing electrical current through at least a portion of said plurality of hooking structures to cauterize the grasped tissue.

5 10. The method of claim 5, wherein said grasper comprises at least one suction tube having an opening, wherein said step of grasping comprises generating a vacuum in said suction tube sufficient to draw and hold tissue from the wall of said tubular anatomical structure against said opening, and wherein said freeing step comprises releasing said vacuum.

10 11. The method of claim 5, wherein said tubular anatomical structure is a fallopian tube.

15 12. A method of grasping the interior of a tubular anatomical structure having a wall and a central lumen, comprising:
positioning a grasper within the central lumen, said grasper comprising an elongated catheter having an inflatable end portion and a plurality of hooking structures positioned about and capable of moving with said inflatable end portion; and
inflating said inflatable end portion until at least a portion of said plurality of hooking
20 structures are forced into said wall of said tubular anatomical structure to grasp tissue of the wall.

25 13. A method of grasping the interior of a tubular anatomical structure having a wall and a central lumen, comprising:
positioning a grasper within the central lumen, said grasper comprising at least one suction tube having an opening; and
generating a vacuum in said suction tube sufficient to draw and hold tissue from the wall
of said tubular anatomical structure against said opening.

14. A device for grasping tissue on the interior of a tubular anatomical structure and applying at least one ligating band to the grasped tissue, comprising:
an elongated tubular element comprising a first end, a second end, and a lumen, wherein
said first end is adapted for insertion into a tubular anatomical structure and
5 configured to hold at least one ligating band on the exterior thereof;
a grasper slidably disposed within said tubular element, said grasper capable of extending
out of said tubular element, grasping tissue on the interior of said tubular
anatomical structure, and retracting into said tubular element with said grasped
tissue to form a tissue bundle; and
10 a pusher movably disposed at said first end of said tubular element and adapted for
pushing said ligating band off said first end of said tubular element.

15. The device of claim 14, further comprising a control segment connected to
said second end of said elongated tubular element and adapted for controlling and
15 mechanically supporting said device.

16. The device of claim 15, wherein said control segment comprises:
a steering control for controlling insertion of said tubular element into said tubular
anatomical structure;
20 an extension control for controlling extension and retraction of said grasper;
a grasp control for controlling grasping of tissue by said grasper;
a push control for controlling said pusher to push one said ligating band off said first end
of said tubular element.

25 17. The device of claim 14, wherein said grasper comprises:
an elongated catheter slidably disposed within said elongated tubular element and having a
inflatable end portion; and
a plurality of hooking structures positioned about and capable of moving with said
inflatable end portion; and

wherein when said inflatable end portion may be expanded by increasing the pressure of a fluid within said elongated catheter.

5 18. The device of claim 17, wherein said elongated catheter comprises an inflatable catheter having a closed end and formed of a pliable material, said pliable material permitting inflation of said inflatable catheter at said inflatable end portion when the pressure of said fluid within said inflatable catheter is increased.

10 19. The device of claim 17, wherein elongated catheter comprises:
a shaft having an outer wall, a central lumen surrounded by said outer wall, and at least one channel through said outer wall providing communication between said central lumen and the exterior of said shaft; and
a balloon attached to said exterior of said shaft and covering a portion of said exterior including said at least one channel through said outer wall, said balloon having an
15 outer surface and an interior, said interior of said balloon communicating with said central lumen of said shaft via said at least one channel.

20 20. The device of claim 17, wherein said plurality of hooking structures comprises a plurality of elongated wires disposed about the circumference of said elongated catheter and substantially parallel with the long axis of said elongated catheter, an end of each said wire being bent outward from said catheter at said end portion to form a hook.

25 21. The device of claim 17, wherein said plurality of hooking structures comprises a plurality of barbs, each said barb comprising:
a shaft having a first end and a second end, said first end secured to said elongated catheter at said inflatable end portion;
a pointed tip at said second end of said shaft;
at least one backward extending point connected to said second end of said shaft and extending toward said first end of said shaft.

22. The device of claim 14, wherein said pusher comprises a pusher balloon having a substantially toroidal shape, fitting around and secured to said first end of said tubular element, and capable of being expanded to push said ligating band off said first end of said tubular element.

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23. The device of claim 14, wherein said pusher comprises a pusher disk having a central aperture sized to fit slidably about said first end of said elongated tubular element and driven by at least one pusher rod linked to and controlled by said control segment.

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24. The device of claim 14, wherein said pusher comprises an elongated tubular sleeve disposed about and coaxial with said elongated tubular element and capable of sliding with respect to said elongated tubular element a distance sufficient to push said ligating band off said first end of said elongated tubular element.

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25. The device of claim 14, wherein said first end of said elongated tubular element is adapted to hold a first ligating band and a second ligating band on the exterior thereof, and wherein said pusher is adapted to extend to at least a first position and a second position, wherein extension of said pusher to said first position pushes said first ligating band off of said first end, and wherein extension of said pusher to said second position pushes said second ligating band off of said first end.

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26. The device of claim 17, wherein said pusher comprises a pusher balloon having a substantially toroidal shape, fitting around and secured to said first end of said tubular element, and capable of being expanded to push said ligating band off said first end of said tubular element.

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27. The device of claim 17, wherein said pusher comprises a pusher disk having a central aperture sized to fit slidably about said first end of said elongated tubular element and driven by at least one pusher rod linked to and controlled by said control segment.

28. The device of claim 17, wherein said pusher comprises an elongated tubular sleeve disposed about and coaxial with said elongated tubular element and capable of sliding with respect to said elongated tubular element a distance sufficient to push said ligating band off said first end of said elongated tubular element.

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29. The device of claim 14, further comprising a drug delivery lumen for delivering a drug into said tubular anatomical structure at said first end of said device.

30. The device of claim 14, further comprising a current source connected to said grasper and configured for passing current through said grasper and into said grasped tissue.

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31. The device of claim 14, wherein said grasper comprises:
an inflatable catheter having a closed end and formed of a pliable material, said pliable material permitting inflation of said inflatable catheter at an end portion when the pressure of a fluid within said inflatable catheter is increased; and
a plurality of elongated wires disposed about the circumference of said inflatable catheter and substantially parallel with the long axis of said inflatable catheter, an end of each said wire being bent outward from said inflatable catheter at said end portion to form a hook; and

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wherein said pusher comprises an elongated tubular sleeve disposed about and coaxial with said elongated tubular element and capable of sliding with respect to said elongated tubular element a distance sufficient to push said ligating band off said first end of said elongated tubular element.

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32. A device for grasping the interior of a tubular anatomical structure, comprising:
an elongated catheter capable of being inserted into the tubular anatomical structure and having an inflatable end portion; and

a plurality of hooking structures positioned about and capable of moving with said inflatable end portion.

5 33. The device of claim 32, wherein said elongated catheter comprises an inflatable catheter having a closed end and formed of a pliable material, said pliable material permitting inflation of said inflatable catheter at said end portion when the pressure of a fluid within said inflatable catheter is increased, and wherein said plurality of hooking structures comprises a plurality of elongated wires disposed about the circumference of said inflatable catheter and substantially parallel with the long axis of said
10 inflatable catheter, an end of each said wire being bent outward from said inflatable catheter at said end region to form a hook.

34. The device of claim 32, wherein said elongated catheter comprises:
15 a shaft having an outer wall, a central lumen surrounded by said outer wall, and at least one channel through said outer wall providing communication between said central lumen and the exterior of said shaft; and
a balloon attached to said exterior of said shaft and covering a portion of said exterior including said at least one channel through said outer wall, said balloon having an outer surface and an interior, said interior of said balloon communicating with said
20 central lumen of said shaft via said at least one channel;
and wherein said plurality of hooking structures comprises a plurality of barbs, each said barb comprising:
a shaft having a first end and a second end, said first end secured to said outer surface of said balloon;
25 a pointed tip on said second end of said shaft;
at least one backward extending point connected to said second end of said shaft and extending toward said first end of said shaft.